THE TELEGRAPHIC JOURNAL.

VOL. II.—No. 45.

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IN our next number we enter upon our third volume. For the sake of general convenience the new volume will in future begin with the new year, instead of on December 1st as heretofore.

In the past we have endeavoured to make the TELEGRAPHIC JOURNAL not a mere ephemeral publication, but a means of diffusing a knowledge of those rapid advances that are being made in electrical science all over the civilized world, and at the same time we have regularly devoted a portion of our columns to the instruction of the student in the theory and practice of the various branches of Electricity. In the future conduct of the Journal our readers may be sure that what is useful will be retained, while improvements of an important character will be made. Telegraphic *employes* will have in these columns a free and ready means of expressing their needs, of seeking information, and of communicating the novel facts they meet with from time to time. Telegraphic engineers will find, as heretofore, original communications, full descriptions of recent electrical discoveries and telegraphic inventions, and early reports of the meetings of their influential Society. To Physicists generally this Journal will, we hope, continue to commend itself from the special information it supplies, and which we believe is almost unsurpassed for the care and accuracy with which it is compiled. But whilst on our part we are thus endeavouring to augment the usefulness of our Journal, we look hopefully to our readers for a general effort to extend its circulation, and so enable us to go from strength to strength.*

THE LOSS OF THE "LA PLATA."

EVERY year as this season comes upon us there follows in its train the usual black list of railway accidents and shipping disasters. Of the latter, one of the most dreadful of late years is the loss of the well-known cable-ship, the *La Plata*, the news of which reached London on Wednesday, the 3rd inst. She had been chartered from the owner (Mr. Henley) by Messrs. Siemens Brothers, for the purpose of laying the last section of the Platino-Brazileira cable, manufactured by that firm. With from 200 to 300 miles of it on board, she left their Works at New Charlton on Monday, the 23rd ult., and after a good run down the Channel dropped the pilot off the Isle of Wight, at 6 A.M. on the following Friday. In the evening of that day a gale sprang up; yet still she held on her way, until on the Saturday morning, she was on the skirts of the Bay of Biscay, with a fearfully high sea running. The weather went from bad to worse all day on Saturday, and by midnight orders were given to set the fore and aft mainsails, to keep the ship up to the wind. But the hurricane blew with such tremendous violence that—to quote the words of one of the survivors—"in a few minutes the sheet was carried away, the sail defied all efforts to take it in, and the canvas was blown out of the bolt-ropes, the remnants being cut away at daybreak." About 2 o'clock on Sunday morning the vessel shipped a very heavy sea, which carried away the port jolly-boat and davits, and in less than two hours afterwards the starboard waist-boat went in the same way. Between 8 and 9 the ship was reported to be making a great quantity of water, and in order to lighten her a portion of the cable was paid out over the bow. Still no headway could be made: by 10 o'clock the fires were all out, and preparations were then made to abandon the vessel. One boat, containing twelve persons, succeeded in getting clear, and three others were afterwards picked up; but these fifteen were all who escaped, for at 12.30 the ill-fated *La Plata* foundered, stern first, with sixty souls on board, including the captain, the first engineer, all the mates, and the whole of the electrical and cable staff—sixteen in number. All the survivors agree in bearing witness to the noble conduct of Captain Dudden, who stuck to his post from the moment when there was even the faintest anticipation of danger; and they likewise testify to the manly bearing of the officers of the electric staff, who "worked nobly at the boats and rafts, getting up stores and provisions, ready to leave the ship," when it became evident that she would have to be abandoned.

The rumours that the *La Plata* had been overloaded, that she was fitted with unusually heavy gear, and the like, are entirely without foundation. Her total capacity was 1656 tons, and at the time she sunk her total load could not have been within 500 tons of that: there were on board 920 tons of cable and machinery, and about 200 tons of coal. She was fitted with the usual picking-up gear common to all the modern cable-ships; and the catastrophe, so far as one can judge, was due to the water having forced its way—through the rents made in the vessel's side—to the fires, and, by extinguishing these placed her wholly at the mercy of the winds and waves.

The following list contains the names of the electric and cable staff, every one of whom has perished:—F. H. Ricketts, chief engineer in charge of the Expedition; C. A. Cramer, assistant-engineer; A. Culhane, assistant-engineer; King (Platino-Brazileira Telegraph Company); Gockelen, electrician; Blake, electrician; Voullaire, fitter; Gericka, fitter; Richardson, jointer; Owen, jointer; Franks, foreman; Kelly, cable foreman; Mitchell, storekeeper; Telbury, engine-driver; Newman, cabin boy; Charles Lowe, diver.

The Lord Mayor has consented to receive subscriptions towards the "*La Plata* Widows and Orphans' Aid Fund." Subscriptions are also received by Mr. W. T. Henley, 110, Fenchurch St. E.C.; The London and Westminster Bank

* If our readers have found our pages useful to themselves, we would beg them to distribute, in suitable quarters, the blank subscription forms, one of which is enclosed in this number, and others can be had on application to the Office, Doy Court, Ludgate Hill, E.C.

St. James's Square, S.W.; Messrs. Grant Brothers and Co., 24, Lombard Street; and by Messrs. Siemens Brothers, 12, Queen Anne's Gate, S.W.

On the night of the 9th inst. the following telegram was received by Messrs. Siemens Brothers;—

"From Desart to Sir James Anderson, for Mr. Henley.

"Boatswain and Quartermaster of *La Plata* landed here. *La Plata* foundered 29th November. Cable thrown overboard to lighten ship. Boatswain and Quartermaster taken down with ship, but rose and got hold of some wreckage, to which they clung until 10 A.M. on 2nd, and were picked up by Dutch cutter *William Renkelzoora*; names, Hooper and Lamont."

THE "CONVERSAZIONE" OF THE SOCIETY OF TELEGRAPH ENGINEERS.

On the evening of Wednesday, the 2nd inst., the *conversazione* given to the members of the Society of Telegraph Engineers by their retiring President, Sir William Thomson, LL.D., F.R.S., was held, by permission of the Council, in the rooms of King's College, Strand. There was a large and distinguished company present, including Mr. W. S. Froude, F.R.S.; Dr. Carpenter, F.R.S.; Professor Foster, F.R.S.; Dr. Gladstone, F.R.S.; Sir W. Charles Bright; Sir Richard Baggallay; Charles Bright, F.R.S.; Sir Richard Baggallay; Baron Reuter; Mr. John Pender; Prof. Hughes; Count Valliermay; Mr. Warren De la Rue, F.R.S.; Colonel Stotherd, R.E.; Major Bateman-Champain, R.E.; Mr. Latimer Clark (the President of the Society for the ensuing year); Mr. W. H. Preece; Major Malcolm, R.E.; Lieut.-Colonel Home, R.E.; Major Beaumont, R.E., &c.

The rooms set apart for the purpose were the physical laboratories, the general and medical libraries, the Museum of George III., and the Marsden Library. These were filled with a varied and interesting display of electrical appliances, including the latest discoveries in telegraphic apparatus, torpedoes, block-signalling instruments, submarine cables, &c. The feature of the evening was unquestionably the "Electro-motograph," exhibited by Mr. Culley, who was unfortunately prevented by a severe illness from being present. This instrument is the invention of Mr. Edison, of Newark, U.S., and a full description of it will be found in No. XL. of this Journal. Second only in interest to this was the Automatic Duplex Transmitter, invented and exhibited by Messrs. Siemens Brothers. It is worked upon the Morse principle, and has been tried with good results upon the lines of the Indo-European Telegraph Company. When the inherent defects common to all new instruments, more or less, have been surmounted, there can be little doubt that it will be extensively employed. Not the least attractive portion of the evening's display, to the practical engineer, was the interesting collection of "faults" that have been cut from submarine cables, and which were also exhibited by Mr. Culley. A specimen of the "teredo," or, as it has now come to be called, the "cable-worm,"—whose ravages are making themselves evident on the cables throughout almost the entire world,—was shown under one of Mr. Browning's excellent microscopes, and proved to be in itself a powerful source of interest. It had been found, a short time since, during the repair of one of the cables crossing over to Ireland, which had gone bad owing to this insect having made its way through the outer sheathing and insulating covering to the copper conductor. A section of lead tube employed in the pneumatic system of the late Electric and International Company, and only quite recently taken up, was exhibited: it appeared to have stood the test of time well, as not the faintest indication of wear could be observed in it. An interesting application of electricity to domestic purposes was shown in one of the electric torch gas-lighters, invented by Mr. Batchelder: it consists of an electrophorus, formed of vulcanite, and of a circular shape, with a rubber of kid; the discharger betwixt them consists of an insulated wire and a bell-shaped cup, which is held over the gas jet. The gas rises into the bell, mixes with the air, and is exploded by a spark which passes betwixt the bell and the wire, when the two plates of the electrophorus are quickly separated. Several valuable specimens were exhibited by the President himself, the most notable amongst these being a tide-guage, and an eclipsing gas-light which served to demonstrate the method of distinguishing light-houses.

We are compelled to content ourselves with simply mentioning Captain McEvoy's admirable display of the materials employed in torpedo warfare; the varied collections of cable specimens, by different manufacturers; the vacuum tubes, induction coils, and the like, without which no telegraphic *soirée* could be considered complete.

The *conversazione* may be chronicled as, in every respect, a success, and reflects the highest credit upon those by whose exertions so excellent a collection was got together.

ELECTRO-DEPOSITION OF METALS.

By J. T. SPRAGUE.

(Continued from p. 349.)

Copper Solutions.—These are of two kinds, according to the nature of the objects in which deposit is to be effected: for all objects on which no action will occur; the cheapest of the salts of copper—the sulphate—furnishes the best solution; it is superior to the nitrate or chloride, because it produces a purer metal. The reason why a nearly pure copper is deposited in electro-metallurgy is not, as many suppose, because the process can only deposit the one metal at a time; it is because the carbon, lead, and tin, in the ordinary metal which forms the anode, are insoluble in sulphuric acid, and are therefore left behind as the dirty coating which covers the anode, while the iron and zinc—which do dissolve—remain in solution, because they require so much higher force in their reduction than copper does: the presence of nitric or hydrochloric acid, or their salts of copper, is objectionable, therefore, as they would carry over some of the impurities which sulphuric acid leaves undissolved.

(1.) *Acid Solution.*—The best working solution consists of a saturated solution of the sulphate of copper, diluted with one-fourth its bulk of water, containing one-tenth by measure of oil of vitriol. This solution is a good conductor, and has water enough to keep the anode free of crystals.

(2.) *Alkaline Solution.*—Objects in iron, zinc, and some other metals, will not take a deposit in an acid solution, and these it is necessary to cover with a thin film in suitable solutions, then finishing in the ordinary solution. Great care must be taken that the object is perfectly cleaned, when the transfer is made, by thoroughly washing off any traces of the alkaline salts, then dipping in the usual pickle, and transferring to the acid solution.

The solution most frequently employed is the *cyanide of copper*, which may be made by means of the battery. Cyanide of potassium is dissolved in water at the rate of three-quarters of an ounce per pint; a large anode of copper is inserted, and a small cathode, which is best placed in a porous cell; the liquid is heated to about 150° F., and current passed from two Bunsen's cells of adequate size until copper begins to deposit on the cathode: the solution is then ready for use. It is better to throw down cyanide of copper from the sulphate with cyanide of potassium, and, after washing, to dissolve it with cyanide of potassium. This solution requires to be worked hot, with a battery power equal to two Bunsen's or six Smee's, and so as to give gas off freely while depositing copper.

The following solution—which I have improved upon one given by Watts—is more advantageous than the cyanide, *because it works cold.* In all other respects it works under similar conditions. The materials per pint of solution are about—Sulphate of copper, ¼ oz.; cyanide of potassium, ½ oz.; strong liquid ammonia, ¼ oz. To make it, dissolve the proper quantity of sulphate of copper in water, add ammonia till all precipitate is re-dissolved, forming a clear blue solution, then add cyanide of potassium till this colour entirely disappears. Ammonia and cyanide are to be added when needed in working; if they are deficient the anode becomes coated with a bluish powder. If too much ammonia is present copper does not deposit readily, as it is re-dissolved.

Rate of Deposit.—As explained (Tel. Journ., vol. ii., p. 348), there is a particular rate of working suited to each solution, and which can be estimated best under the form of *density of current* in chemics per square inch of surface of object: the form and size of the object will, however, introduce some modifications; thus a spherical object with no edges or projecting points would bear a much higher density of current than small plates. The following experiments were made with a plate 1 inch square, with only one side exposed, and in each case continued until a quarter equivalent—8 grains—was deposited, giving a thickness equal to stout paper, and the currents were constant, from a Daniell's battery controlled by resistances:—

1.—0·1	chemic,	30	hours,	excellent coating.
2.—0·2	„	15	„	good tough copper.
3.—0·5	„	5	„	a beautiful deposit.
4.—1·0	„	2½	„	very good.
5.—2·0	„	1¼	„	sandy at edges.
6.—3·0	„	¾	„	bad all round.

The first four deposits were scarcely distinguishable, being all sound tough metal; in 5 and 6 the middle portion was similar, but all round the plate the metal was loose and sandy.

It would appear, therefore, that for this solution, the acid one above described, the density of current may rise to 1¼ units, or be as much slower as is desired. In silver and other solutions the rate suitable will greatly depend upon the condition of the solution, as to the presence of free solvent, other salts, &c.

The electromotive force required for depositing metals is about—

1. Copper	... ... Volts	0·5 to 1·0
2. Silver	... ... „	1·5 „ 2·0
3. Gilding	... ... „	0·3 „ 0·5

The working forces of the ordinary batteries are about—

1. Copper zinc in acid	... ... Volts	0·3
2. Smee	... ... „	0·5
3. Daniel	... ... „	1·0
4. Nitric acid cells	... ... „	1·6

Therefore one Smee or Daniell is suitable for coppering in the acid solution, three Smee's or one Grove for silvering, and one copper or Smee for gilding, provided power is not wasted by bad connections, thin or long wires, &c.: for quick deposits higher forces are required.

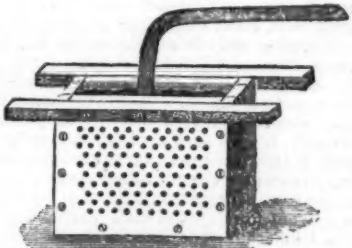
Resistances should be balanced, and, as a rule, the area of objects, anodes, and battery plates may be about equal, subject, however, to the general principles of management.

The *anodes* should be of the same metal as is being deposited, and should be of the purest metal obtainable, fine silver and gold, in those solutions, in order to maintain the solution uniform in quality. As a rule they should be in sheets, suspended round the vessel, and distributed among the objects, in such manner as to secure the carrying out of the conditions of equal resistance at all points already explained; for wherever the resistance is greatest there the deposit will be thinnest, and whenever any part of the surface has a much lower resistance than other parts, there the current will be in too great proportion, and not only will there be excess of deposit, but its quality will be likely to be injured.

Scraps of copper may be used in place of sheets, on a plan published by M. Charles Guerin, the following description of which is taken from the *Scientific American*:—

Fig. 1 is a representation of the receptacle used for holding the copper scraps. It is simply a

Fig. 1.



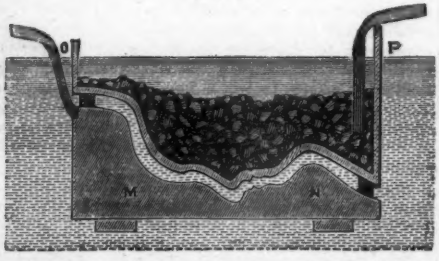
prismatic box, about 1¼ inches broad, sustained in the bath by the two longitudinal rods shown at the top. The acting sides are pierced each with about 100 holes of 0·1 inch in diameter, per 16 square inches, and are of oak or beech wood, and about 0·2 inch thick. Before it is put together, the apparatus is plunged in a bath of melted wax or covered

with several coats of gum-lac varnish, in order to protect the parts from the action of the acid, and brass screws are used to connect it together.

The following practical hints will be of use in selecting scraps to fill the receptacle:—Choose pieces free from solder or rivets of brass or iron. Flatten out with a hammer such bits as are curled up, and divide with shears those of irregular form, so that all may fit closely upon each other. With these, pack the receptacle as uniformly as possible. For the band of copper, which serves as a conductor, choose a long piece, so that it may bury anew in the mass as its lower end becomes dissolved. Every four or five days stir the pieces vigorously with a brass rod, so that they may be freed from any film of impurity which may form upon them.

The decomposing action of a current acts in inverse ratio to the distance, so that, under ordinary circumstances, the deepest portions of the moulds are the weakest. This is a decided inconvenience in cases of objects in high relief, and which are liable to prolonged rubbing or repeated shocks. The soluble anode, in its rectangular form as before described, acts exactly as a plate, and hence gives proofs of unequal thickness; but if the active surface of the receptacle, instead of being flat, be so disposed as to form a sort of counterpart following the contour of the mould, the deposit will have a uniform thickness: this is illustrated in Fig. 2.

FIG. 2.



M N is the mould in section; over it, at a distance of 0·3 inch, is arranged a gutta-percha box, O P, of which the bottom is perforated with a large number of small holes. This box first has its bottom covered with linen cloth, and is then filled with copper scraps, and the copper conducting band is inserted.

In order to localise or concentrate the galvanic action at certain places, it is only necessary to heap up the copper pieces at the desired points; and conversely, when a part has become covered with a deposit of sufficient thickness, it is obviously unnecessary to employ the protecting coverings of wax or gutta-percha ordinarily used with plate anodes. The mode of forming the gutta-percha counterpart consists in coating the interior of the mould with several layers of fine thin plaster for a thickness of 0·3 inch. This is allowed to harden. Into the hollow cast the gutta-percha, softened by warm water, is pressed with the hand, so as to cause it to conform to the indentations of the plaster, care being taken to keep it of uniform thickness. After cooling it is easily removed, and after perforation is ready for use, as above described. It is, of course, a reduced copy of the interior of the mould.

ON THE MEDIUM IN ELECTRIC INDUCTION.

By Dr. H. BRONGERSMA.

(Concluded from p. 380.)

AFTER the various objections to Faraday's theory have been refuted, it remains for us to examine whether the results of our experimental investigation are in perfect harmony with that portion of the theory which relates to the specific inductive power of bodies. That the disk D, when introduced into the space between A and B,—as long as it is neutral, or even after a gradual separation of the electricity has taken place, so that the one side has become negative and the other just as strongly positive,—must occasion an increase of the induced electricity, on the supposition that its specific inductive power is greater than that of the air, requires no proof. But even then, when the side of the disk turned towards A—which we may call *a*—contains more negative electricity than the other side (*b*) contains positive, or on the supposition that the side *a* is negative and the side *b* neutral, it will, according to this theory, occasion at first an increase of the induced electricity, until the negative charge on *a* has attained a certain magnitude. For if we assume that the first stratum of molecules on the side *a*, bordering on the molecules of the air, contains more negative than positive electricity, the latter—after a separation of the electricity in these molecules has taken place, under the influence of the positive electricity upon A—acts distributively upon the molecules in the next following stratum, and so on, until finally the molecules of the last stratum on the surface *b* act distributively upon the molecules of the air. It is now very possible that this action may be more powerful than it would be if the disk were absent, and if its place were filled with molecules of air. If the quantity of negative electricity upon the surface *a* increases, the distributive action upon the following molecules, and consequently that also upon the first layer of air-molecules between D and B, will diminish, until the latter becomes ultimately smaller than it would be if D were replaced by molecules of air. Thus the influence of D would occasion a decrease of the induced electricity on B. Faraday's theory is so decidedly confirmed by our experimental investigation that any further researches are needless. But Riess has not merely attributed a great influence to the dimensions of the disks under examination, but also to those of the metallic conductors between which these disks are placed. That the influence of the shape and size of the disks in question is considerable, especially of such whose surfaces are strongly conducting, is evident from the experiments with glass disks. In the experiment with disk N, which has the largest diameter, a decrease was perceived in the first observation in damp air, and in dry air much sooner than with the other disks, though all were cut out of the same plate. In order, also, to examine the influence of the form of the conductor, the author replaced the copper disks of his apparatus A and B with brass balls, which we may also call A and B. Their diameter was 50 m m., and they were so fixed that the distance of the centre was 50 m.m. The line uniting the centres of the balls was perpendicular to the centre of the disks in question which were equidistant from the surface of both globes. It must

be remarked that the experiments, both in damp and dry air, were conducted under cover of the glass case. The investigation took place in the months of July and August of the past year, during which the hair hygrometer stood constantly above 50°. By heating the room to 30° C., the hygrometer was, indeed, lowered to 46°, but even then the glass disks and some of the others were electro-negative when they approached the space between the conductors A and B, and before they had taken up their intended position. By placing a little sulphuric acid in the covered apparatus, and by partially closing the aperture in the table at C, it became possible to render the degree of moisture in the apparatus exactly the same as that recorded during the first series of experiments.

The results of these experiments are given in the subjoined tables:—

A'.

Shellac disk; diameter 124 m.m.; thickness, 4 m.m.

1.	2. Time.	3. Therm.	4. Hygr.	5. Induced Electricity on B.	6. Electric Condition of Disk D.
Damp air	0 m.	24° C	34°	Increased	Neutral
"	4 "	"	"	"	Negative
"	21 "	"	"	Decreased	"
Dry air	0 "	24°	5°	Increased	Neutral
"	8 "	"	"	"	Negative
"	60 "	"	"	Decreased	"

C'.

Shellac disk; diameter 80 m.m.; thickness, 2 m.m.

Damp air	0 m.	24° C.	35°	Increased	Neutral
"	5 "	"	"	"	Negative
"	21 "	"	"	Decreased	"
Dry air	0 "	24°	3°	Increased	Neutral
"	15 "	"	"	"	Negative
"	60 "	"	"	Dec.—Inc.	"
"	85 "	"	"	Decreased	"

D.

Paraffin disk; diam., 156 m.m.; thickness, 10 m.m.

Damp air	0 m.	25° C.	39°	Increased	Neutral
"	4 "	"	"	"	Negative
"	20 "	"	"	Dec.—Inc.	"
"	25 "	"	"	Decreased	"
Dry air	0 "	25°	3°	Increased	Neutral
"	9 "	"	"	"	Negative
"	30 "	"	"	Dec.—Inc.	"
"	85 "	"	"	Decreased	"

E.

Paraffin disk; diam., 112 m.m.; thickness, 12 m.m.

Damp air	0 m.	24° C.	35°	Increased	Neutral
"	5½ "	"	"	"	Negative
"	35 "	"	"	Decreased	"
Dry air	0 "	20°	5°	Increased	Neutral
"	7 "	"	"	"	Negative
"	110 "	"	"	Decreased	"

F.

Paraffin disk; diam. 150 m.m.; thickness, 5 m.m

Damp air	0 m.	24° C.	36°	Increased	Neutral
"	5 "	"	"	"	Negative
"	23 "	"	"	Decreased	"
Dry air	0 "	24°	3°	Increased	Neutral
"	20 "	"	"	"	Negative
"	65 "	"	"	Decreased	"

G.

Ebonite disk; diam. 154 m.m.; thickness, 2 m.m.

1.	2. Time.	3. Therm.	4. Hygr.	5. Induced Electricity on B.	6. Electric Condition of Disk D.
Damp air	0 m.	24° C.	35°	Increased	Neutral
"	½ "	"	"	"	Negative
"	1½ "	"	"	Decreased	"
Dry air	0 "	20°	7°	Increased	Neutral
"	2 "	"	"	"	Negative
"	5 "	"	"	Decreased	"

H.

Sulphur disk; diam. 154 m.m.; thickness, 4 m.m.

Damp air	0 m.	24° C.	34°	Increased	Neutral
"	1 "	"	"	"	Negative
"	11 "	"	"	Decreased	"
Dry air	0 "	20°	7°	Increased	Neutral
"	12 "	"	"	"	Negative
"	18 "	"	"	Dec.—Inc.	"
"	25 "	"	"	Decreased	"

J.

Glass disk; diameter, 50 m.m.; thickness, 1¾ m.m.

Damp air	0 m.	24° C.	35°	Increased	Negative
"	5 sec.	"	"	Decreased	"
Dry air	0 "	22°	6°	Increased	Neutral
"	1 "	"	"	"	Negative
"	2 "	"	"	Decreased	"

K.

Glass disk; diameter, 80 m.m.; thickness, 1¼ m.m.

Moist air	0 m.	24° C.	35°	Dec.—Inc.	Negative
"	5 sec.	"	"	Decreased	"
Dry air	0 "	20°	7°	Increased	Neutral
"	½ "	"	"	"	Negative
"	1½ "	"	"	Decreased	"

L.

Glass disk; diameter, 110 m.m.; thickness, 1¼ m.m.

Damp air	0 m.	24° C.	33°	Decreased	Negative
Dry air	0 "	21°	6°	Increased	Neutral
"	½ "	"	"	"	Negative
"	1 "	"	"	Decreased	"

L'.

Varnished glass disk. (Same as L.)

Damp air	0 m.	24° C.	35°	Unchanged	Negative
"	½ "	"	"	Decreased	"
Dry air	0 "	20°	7°	Increased	Neutral
"	½ "	"	"	"	Negative
"	2 "	"	"	Decreased	"

M.

Glass disk; diameter, 130 m.m.; thickness, 1¼ m.m.

Moist air	0 m.	24° C.	35°	Decreased	Negative
Dry air	0 "	22°	7°	Increased	Neutral
"	½ "	"	"	Decreased	Negative

N.

Glass disk; diameter, 155 m.m.; thickness, 1¼ m.m.

Damp air	0 m.	25° C.	35°	Decreased	Negative
Dry air	0 "	22°	6°	Unchanged	Neutral
"	½ "	"	"	Decreased	Negative

O.

Mica disk; diameter, 155 m.m.; thickness, ½ m.m.

1.	2. Time.	3. Therm.	4. Hygr.	5. Induced Electricity on B.	6. Electric Condition of Disk D.
Damp air	0 m.	25° C.	34°	Decreased	Negative
Dry air	0 „	24°	7°	„	„

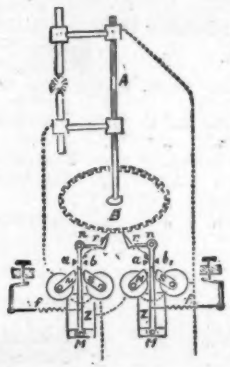
From these experiments it is plain that Riess is perfectly right in ascribing a certain influence to the form of the conductor. In damp air, even in this case, the glass disks L, M, and N became electro-negative before reaching the space between A and B, and consequently at once increased the amount of induced electricity upon B. The other disks also occasioned a decrease of the induced electricity in a shorter time than in the former series of experiments where the conductors also were disks. Further, in the experiments with spherical conductors, the increase of the induced electricity on B, when the non-conducting disks were inserted between A and B, was much smaller than in the first series. It is not difficult to show that this must be the case. The increase of force occasioned by a condenser is—other things being equal—much smaller when the conductors are spheres of a given diameter than when they are disks of the same diameter. If the diameter of the disks is much greater than that of the spheres, as was the case in these experiments, the difference in the amount of increase will be still greater, since the latter augments with the diameter of the disks. If, therefore, in the first series of experiments, the same amount of electricity was imparted to the disk A as to the ball B in the second, then in the former case the amount of induced electricity on the disk B will be considerably greater than that in the second case upon the ball B. If we can assume that the number which expresses the specific inductive power of a substance is constant,—*i.e.*, independent of the strength of the charge of A,—then, if we express this number by m, on introducing the disk into the space between A and B, the induced electricity upon B will be increased by the $\frac{1}{m}$ part, on the supposition that the entire space is taken up by the disk. In our case the increase would not be so great, but it would be a constant number for one and the same disk. If the amount of induced electricity upon B is smaller in case of globular than of disk-shaped conductors, then the increase of the electricity induced upon B by the influence of the non-conducting disk will be smaller in the first case than in the second.

The experiment with glass disks is certainly of little importance, since it has a great conducting power on its surface, as appears from the tables. That glass is little suited for such investigations is admitted by others. The mica disk was the most conductive, so that we cannot ascribe the slightest value to the results therewith obtained.

It appears also that the increase of the induced electricity upon B was greater the thicker the non-conducting disks of the same material. Into this consideration the author declines to enter, as not affecting his immediate object. The results would indubitably have been more decisive in favour of Faraday's theory if it had been possible to have made the rods, upon which the non-conducting disks were fixed, more perfect insulators.

SIEMENS AND HALSKE'S SELF-REGULATING ELECTRIC LAMP FOR ALTERNATING CURRENTS.

This new lamp is exclusively designed for the application of currents whose direction is constantly changing, as generated by certain magneto-electric machines specially constructed for the production of the electric light, and can be advantageously used on account of the better combustion of the carbon points. It regulates the length of the electric arch of light with uncommon nicety, and is moreover distinguished by the great simplicity of its fundamental principle, which is carried out without wheelwork. All the movements requisite for generating the electric light and regulating its length are produced by two polarised electro-magnets. Between the poles of each of these magnets (N S and N' S') a steel tongue (Z Z'), permanently polar-



ised by a powerful steel magnet placed behind it (M M'), moves to and fro as far as the two stops ($a\,b$ and $a'\,b'$) permit. In consequence of the change of poles continually produced in the electro-magnets by the influence of the alternating currents, and of the resultant varying attraction of the tongues, the latter are thrown into an oscillatory movement, when they are not, in addition, drawn towards their respective stops ($a\,b$, $a'\,b'$), by springs ($f\,f'$) capable of being regulated.

It thence results that the strength of the currents passing through the coils of the two electro-magnets must have reached a certain strength—according to the tension given to the springs—before it is able to overcome the latter, and to cause the magnetic tongues to vibrate.

Each tongue carries, at its prolonged extremity, a catch ($n\,n'$). These catches, with their points turned towards each other, play against the wheel B, set with fine rectangular teeth, in such a manner that B is turned by the movement of the tongues and the consequent pushing of the catches. The rotation varies in direction, according as one or other of the tongues is acting. In order that the catch which is at rest may not hinder the wheel from obeying the impulse given by the other, each catch is lifted out of the teeth of the wheel by a pin ($r\,r'$), which runs up an inclined plane as soon as the tongue approaches the stop ($a\,b'$).

The axle (A) of the wheel is prolonged upwards, and carries a right and a left thread, on which the two carbon holders screw themselves in opposite directions, either higher or lower, and consequently either approach each other or recede from each other, according as the wheel is turned in one or in the other direction.

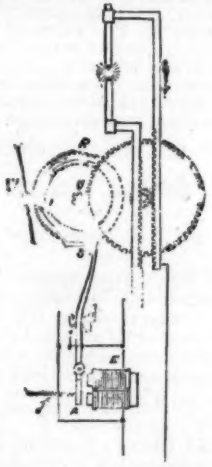
The coil of the electro-magnet (N S), which in the manner described above produces the mutual removal of the points, consists of a few layers of thick wire, and lies in the same circuit as the luminous arch. The coil of the other magnet (N' S'), which causes the carbon points to approximate each other, are formed of many folds of thin wire, and so arranged that they form a bye-circuit to the luminous arch, but of far greater resistance. When the lamp is in action, according as the length of the arch varies, so does the consequent increase or decrease in resistance. The current in the folds of the electro-magnet lying in the direct circuit becomes weaker or stronger, whilst the current in the folds of the other electro-magnet—which lies in the bye-circuit—changes inversely, according to the law of branch currents, and consequently increases as the luminous arch grows larger.

In consequence the one or the other magnet will act more powerfully, and the wheel will turn chiefly in the one or in the other direction, *i.e.*, in the one required to correct the change which has taken place in the distance of the points.

If the lamp is extinguished by any external cause, that electro-magnet only which tends to bring the points together has a current. This ceases as soon as the points touch each other, and in the same moment an intense current is excited in the other magnet, which rekindles the light, and restores the arch to its former position.—*Carl's Repertorium fur Experimental-Physik.*

SIEMENS AND HALSKE'S SELF-REGULATING ELECTRIC LAMP, APPLICABLE FOR CURRENTS WHETHER OF SIMILAR DIRECTION OR ALTERNATING, ACCORDING TO VON HEFNER-ALTENECK'S DESIGN.

In this new lamp the length of the arch of electric light is regulated so that the carbon points approach each other, influenced by the preponderance of the upper supporter, and again recede from each other by



the action of a small electro-magnetic machine, impelled by the current which produces the light. This machine consists of a horse-shoe magnet, E, surrounded with coils, and provided with a keeper, A, which the spiral spring *f*—capable of being regulated—tends to draw away from the poles of the electro-magnet and against the stop *d*. When the keeper touches the magnet the contact *c* is formed, which allows the current to take a shorter path without traversing the coil. The keeper consequently falls off, breaking the contact *c*, when it is, of course, again attracted. As soon, therefore, as the electric current—and consequently the magnetism which it excites in the electro-magnet, in consequence of the approximation of the carbon points—has become strong enough to overcome the tension of the spiral spring *f*, the keeper is thrown into oscillatory movements, which continue until the strength of the current falls below the required limit. These oscillations are transmitted to a small catch, *s*, which acts upon the catch-wheel U with its slanting teeth, and so, by means of the cog-wheels, slowly withdraws the two carbon-holders from each other, acting in opposition to the preponderating weight of one of them. In consequence of the thus increasing resistance of the electric arch, and the weakening of the electric current, the oscillatory movements of the keeper and the catch soon cease, and the keeper remains lying against the stop *d*. In this position the catch is lifted completely out of the teeth of the wheel U by the pin *n*, which is fixed to the frame of the lamp, up which it runs with an inclined surface. The preponderance of the upper carbon-holder comes then into play, and causes the carbon points to approximate each other, pressing the wheel U backwards, until, in consequence of the accompanying increase of the strength of the current, the oscillatory movements of the keeper and the catch begin again. The speed with which the carbon points approach each other is retarded by the vane W, and in order that the electro-magnet may not turn this in another direction, its driving-wheel, R, is set loose upon the axle of the catch-wheel U, and connected with the latter by means of the latch *t* for movement in one direction only, as produced by the greater weight of the upper carbon-holder.

In the ordinary working of the lamp the alternating movements of the carbon points are scarcely perceptible. If the luminous arch is extinguished by any external cause, the carbon points at once fall together, and are again separated by the electro-magnetic action, when the electro-luminous arch reappears in its original length, as determined by the tension of the spring *f*.

In the application of so-called alternating currents, such as are under certain circumstances produced by dynamo-electric machines, the lamp, and especially the electro-magnetic apparatus, work in the same manner, with the sole difference that the oscillations of the keeper are produced, in consequence of the constantly changing polarity, without the aid of *c*. But if the luminous electric arch is to preserve its position for any length of time, the relative speed with which the carbon points move must be altered, for, as is well known, in case of currents of similar direction the carbon connected with the positive pole burns twice as fast as the other. With alternating currents this is not the case. Accordingly the arrangement is made so that by turning a handle, placed without the lamp, both the racks fixed to the carbon-holders can be made to play either into one pinion or into two pinions on the same axle, the diameters of which are as 1 to 2.

Independently of its twofold applicability, this lamp is distinguished by its great simplicity, along with great accuracy in regulation. Its external form is pleasing, and all the principal parts can be taken out with the hand by merely unfastening two screws.—*Carl's Repertorium für Experimental-Physik.*

The traffic receipts of the Great Northern Telegraph Company for the month of November were—This year, 363,152 francs; last year, 316,616 francs. Total traffic receipts, 1st January to 30th November—This year, 4,133,552 francs; last year, 3,065,184 francs.

TECHNICAL EDUCATION IN IRELAND.

ROYAL COLLEGE OF SCIENCE, STEPHEN'S GREEN, DUBLIN.

The Royal College of Science was established by the Science and Art Department in 1867, and holds a position in Dublin similar to that of the School of Mines in London. The professional staff of the Royal Dublin Society and that of the Museum of Irish Industry were combined, new Chairs were founded, and the Royal College of Science—with a complete staff of professors, a museum, and library—was opened for the reception of students. The instruction given at the College of Science during the three years' course has special bearings on the industrial arts, classed broadly under the heads of Mining, Agriculture, Engineering, and Manufactures. The student of the industrial arts is thus able to obtain a complete course of instruction in any of the special branches above enumerated at a small cost, and without leaving his own country. Besides these evident advantages, exhibitions and scholarships are awarded yearly to the best students. There is another advantage, which ought to be widely known and appreciated—namely, that students who can obtain subscriptions of £25 per year from their own neighbourhood can obtain from the Science and Art Department an additional £25 and free education at the Royal College of Science as local exhibitioners.

There are four Royal Scholarships and nine Royal Exhibitions attached to the College. The Royal Scholarships, which are of £50 yearly value each, with free education, are tenable for two years. Two become vacant each year, and they are awarded to students who have been a year in the College. The nine Royal Exhibitions, of £50 yearly each, are tenable for three years, with free education. The holders of these must pass the examination required for the Associateship of the College. Three of the Royal Exhibitions are open for competition annually at the May Examination of the Science and Art Department. Medals and other prizes are also awarded to students for the best answering in each subject at the examinations held in June.

The course of instruction extends over three years. During the first and second year the instruction is general, the student devoting his time to the study of the sciences bearing upon the industrial arts. In the third year the study is specialised, and the attention of the student is concentrated on one of the four subjects—Mining, Agriculture, Engineering, or Manufactures. The College is also intended to aid in the instruction of teachers for the local schools of science. On the completion of the third year the student may obtain the diploma of Associate of the Royal College of Science. It is not necessary that the student should attend the complete course, and take the diploma, but any of the classes may be taken separately by those who only want instruction in some special subject. There are nine Chairs in the College—Chemistry, held by Prof. R. Galloway, F.C.S.; Applied Mathematics, Prof. H. Henessey, F.R.S.; Descriptive Geometry and Engineering, Prof. T. F. Pigot, M.R.I.A.; Physics, Prof. W. F. Barrett, F.R.S.E., F.C.S., M.R.I.A.; Geology, Prof. E. Hull, M.A., F.R.S; Mining and Mineralogy, Prof. J. P. O'Reilly, M.R.I.A.; Botany, Prof. W. R. M'Nab, M.D.; Zoology, Professor A. Leith Adams, M.A., M.B.; Agriculture, Prof. E. W. Davy, A.M., M.D., M.R.I.A.; Palæontological Demonstrations are given by the Demonstrator, Mr. W. H. Baily, F.L.S., F.G.S., M.R.I.A. The Assistant-Chemist is Mr. Wm. Plunkett, F.C.S. The duties of the Secretary are ably discharged by Dr. F. J. Sidney, M.R.I.A.; and Mr. Alphonse Gages, M.R.I.A, is the Librarian and Curator of the Museum.

The following extract from Prof. Barrett's outline of lectures concerns the subject of our Journal, and may be of interest to our readers:—

Experimental Physics.—A course of 90 lectures on Physics is also embraced in the first year's study. Three lectures are given each week, accompanied by experimental demonstrations. From the syllabus of the course drawn up by Prof. Barrett, we make the following epitome:—The course commences with an historical sketch of the development of experimental science, and the method, aim, and scope of experimental enquiry. The student is then briefly made acquainted with the various manifestations of energy. The law of the conservation of energy; the transmutation of energy; the estimation of energy by work done; and the degradation and dissipation of energy. The physical properties of solids, liquids, and gases are then discussed. Sound, Light, and Heat are next dealt with, in an extended series of lectures. Electricity and Magnetism follow these subjects, and the practical application and measurement of electric currents are treated at length. A short course on Meteorology concludes this branch of study. A large additional Physical Laboratory is now being fitted up for the use of students attending Prof. Barrett's lectures, so that a course of practical work will hereafter form part of the regular instruction.

Notwithstanding the wide range of subjects embraced, the soundness of the instruction given in the College seems well attested by the fact that since the Whitworth Scholarships have been offered for public competition one or more have been taken each year by students in the College. This is, we believe, with a single exception, the only instance in which these scholarships have been obtained by pupils receiving instruction in Irish schools or colleges. Some of the students of the College have also distinguished themselves at the higher examinations of the London University and elsewhere.

Those who, like ourselves, have had the pleasure of personally inspecting the different departments of the College cannot fail to be amazed at the magnificent appliances for scientific instruction possessed by the Royal College of Science. Considering its comprehensive character, it is quite unique in this country. We are surprised that it is not more widely known, nor more advantage taken of the help it was intended to offer to students of the applied sciences. The Directory of the College, containing further details, and the full outline of the several courses, can be had, post free, on application to the College.

Students' Column.

Resistances and their Measurement. By H. R. Kempe.

XV.—The highest resistance it is possible to measure by means of the Wheatstone bridge we have described is 1,000,000 ohms. It is true that some bridges have another set of resistances in the top row, which will enable the ratio 10 to 10,000 to be used, and consequently a resistance of—

$$\frac{10{,}000 \times 10{,}000}{10} = 10{,}000{,}000$$

to be measured, but this is not often the case, and resistances much greater than this frequently require to be measured. To measure such high resistances a different method must be adopted, which we will now describe. It is a modification of the deflection method we gave in Article II. Provide a single, and also about 100 constant cells. Find their respective electromotive forces by the dis-

charge method we gave in our last article. The electromotive forces of one cell and 100 cells being largely different, a difficulty may arise in doing this which we will point out. Suppose we were taking the discharge from the one cell, which, as we have explained, should be taken first, and obtained a discharge deflection of 300°, having adjusted the galvanometer shunt for this purpose to 560 ohms. Now, on inserting the 100 cells in the place of the one cell. we should perhaps find that a shunt of 6 ohms gave a discharge deflection of 302°, and one of 5 ohms a deflection of 297°, or even a greater difference than this. As no nearer adjustment of the shunt is possible, a little extra calculation becomes inevitable. Note the shunt which gives the deflection nearest to 300°. In this case it will be 6 ohms, which gave 302°. Now multiply the 302° by—

$$\frac{\text{Galvanometer} + \text{shunt,}}{\text{shunt}}$$

and we get the deflection we should have had had no shunt been used. Let this represent the electromotive force of the battery. In like manner, multiply the 300° we obtained with the one cell by—

$$\frac{\text{Galvanometer} + \text{shunt,}}{\text{shunt}}$$

and we get the number representing its electromotive force. Giving the numerical values, the ratio of the electromotive force of the 1 cell to the electromotive force of the 100 cells will be—

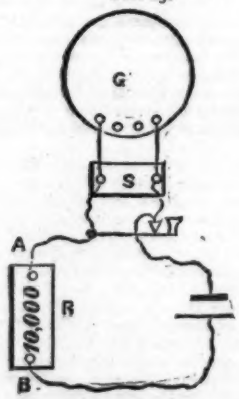
$$300^{\circ} \times \frac{5000 + 560}{560} : 302^{\circ} \frac{5000+6,}{6}$$

or as 1,000,800 : 84,661,472.

If now we divide the greater number by the less, we get the value of the 100 cells in terms of the 1 cell. This value we find to be 84·6, that is, the 100 cells is 84·6 times stronger than the 1 cell, and not 100 times as strong. This might arise from some of the cells being defective, or imperfectly insulated. This does not matter, however, as long as we determine, as we have done, how much more powerful the 100 cells is than the one cell.

Having found the value of the 100 cells in terms of the single cell, we next proceed to join up the galvanometer, with a shunt and short-circuit key between its terminals, in circuit with a resistance coil and the single cell, as shown by Fig. 25.

FIG. 25.



Put a resistance of 10,000 ohms in R (a resistance of 10,000 ohms in a separate box is often used for this measurement), and having first inserted all the plugs in S, press down the short circuit-key, and proceed to remove some of the plugs, until a deflection of 300° is obtained, then raise the key, and see if the spot of light comes back to zero properly; if it does not, see that the cause is not from the short-circuit key not making proper contact, by disconnecting one of the wires. If this does not have the required effect, the adjusting magnet of the galvanometer must be slightly shifted, and, if necessary, put a little lower down, so as to make the needle a little less sensitive. After two or three trials this will be satisfactorily done, and the spot of light will always come back to the zero-point when no current is passing through the galvanometer. It may not be possible in this case also to get 300° exactly, but the nearest deflection to it must be obtained and noted. Let us suppose 301·5° were obtained, the shunt being 7 ohms. Now multiply 301·5° by $\frac{5000 + 7}{7}$, which gives 215,658. This, then, is the deflection we should get through 10,000 ohms with no shunt to the galvanometer. There is really in the circuit, besides the 10,000 ohms, the resistance of the one cell, and also the resistance of the galvanometer and shunt combined (which will be of course less than 7 ohms), but this will be so small as to be of no consequence; it may, however, be subtracted from the 10,000 if preferred. The resistance of the battery can be plugged up in the 10,000 resistance before commencing. The galvanometer and shunt we cannot allow for at starting, as we do not know what the shunt resistance will be. If R is only a single resistance of 10,000 we cannot of course reduce it to allow for the battery.

Now, if we had used the 100 cells instead of the one cell, our deflection would have been 84·6 times as great as with the one cell. If, then, we multiply 215,658 by 84·6, we shall get the deflection obtainable by the 100 cells through a resistance of 10,000. This value will be found to be 18,244,737. Multiplying this number by 10,000, or 10,000 *minus*, the combined resistance of the galvanometer and shunt, if preferred, we get the constant. This process is simplified by using a resistance of 1,000,000 in the place of the 10,000. The constant can then be taken with the 100 cells at once. The object of using the one cell for the constant is to enable a readable deflection to be obtained, as 100 cells through 10,000 ohms would throw the spot of light off the scale with the lowest shunt we could use.

Having measured and worked out the constant, which is best done by the help of logarithmic tables, we insert the resistance which is to be measured between A and B, in the place of R, using 100 cells in the place of the one cell. Having adjusted S till a deflection of 300°, or as near to 300° as possible is obtained, note S and the deflection. Let S be 2500, and the deflection 298°. Then the deflection without the shunt would be—

$$298 \times \frac{5000 + 2500}{2500} = 894.$$

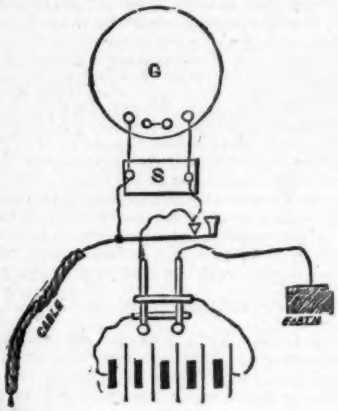
Dividing the constant by this number we get—

$$\frac{182,447,370,000}{894} = 204,080,000 \text{ ohms.}$$

as the resistance.

In measuring the insulation resistance of a cable, the constant having been taken, we should join up the galvanometer shunt, short-circuit key, reversing key, battery, and cable, as shown by Fig. 26. If

Fig. 26.



preferred, the reversing key may be put on to the galvanometer, using a quadrant reversing switch for the battery. This will save the trouble of reversing the wires on the galvanometer when the battery current is reversed, as it can be done more readily by means of the key. The object of reversing the galvanometer connections when the battery is reversed, is to obtain the deflection always on the same side of the scale.

The ends of the cable must be trimmed by means of a sharp and clean knife, care being taken that the outer surface of the gutta-percha, which has been exposed and oxidised by the air, is completely cut away, and the clean surface thus exposed not touched with the fingers. Some electricians prefer to have the ends then rubbed with a rag soaked in paraffin oil, but this is not absolutely necessary if the trimming is carefully done. Indeed, if the paraffin is not of good quality, it conducts slightly, and may be prejudicial.

The ends being carefully trimmed, and the further end left hanging free, so as not to touch anything, the nearer end of the cable must be attached to the terminal screw of the discharge key, care being taken not to touch the trimmed end in doing so. The reversing key, which puts the zinc current to the cable (the left-hand in the sketch), may now be clamped down, and the short-circuit key being depressed, sufficient resistance inserted in the shunt to obtain a deflection of about 300°. At the end of a minute from the time the battery key was clamped down, the exact deflection obtained must be noted, and as the spot of light continues to fall down the scale, which it will do, the deflections at the end of each minute for about five successive minutes must be noted, the shunt remaining unaltered. The connections of the shunt with the galvanometer must now be reversed, so as to change the direction of the current through it, and then the second battery key must be clamped down, the first one having been released, and deflections again noted at intervals of a minute, as before, until the same number of readings are obtained.

Before commencing the testing it is as well to put the 100 cells direct on to the cable for about half-an-hour, reversing the current at intervals of two or three minutes, finishing with the zinc current. Then to leave the end to earth for about the same period, and having taken the test with the zinc current, to reverse the current for a minute or two, and, finally, having put the cable to earth for about a quarter-of-an-hour, to take a test with the copper current.

It will be found that the deflections with the copper current will be lower than those with the zinc current, and, also that the fall of the deflection in both cases will be quick at first, and will afterwards slowly decrease. The tests with the cable being finished, the deflection obtained by one cell through 10,000 may be repeated, and if any difference is observed between it and that taken at first, the mean of the two should be taken. The resistance at the end of each minute may now be worked out from the different deflections obtained.

When the cable is connected to the testing instruments by a long leading wire, at the conclusion of the test the end of the lead should be disconnected from the cable, and insulated. If any deflection is observable on the galvanometer when the battery current is put on, this deflection must be subtracted from the deflection obtained when the cable was attached to it. The ends of the lead must be trimmed in the same manner as the ends of the cable.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

The annual meeting of this Society was held on Wednesday evening last, the 9th inst.

Mr. Latimer Clark, Vice-President, took the Chair.

The annual report of the Council was read by the Secretary, Mr. G. E. Preece. It stated that an accession of 131 members of all classes had taken place during the year, and showed the Society to be in a most satisfactory and prosperous condition. The council had to record the loss of Mr. Ricketts, one of the first members of the Society, who had met with an untimely end through the foundering of the steamship *La Plata*.

The Chairman expressed the sympathy of the Society with the families of those electricians who had perished in the *La Plata*. One of them (as stated in the report) was a member of the Society, and another was a relative of the President, Sir William Thomson. He hoped that all the members would subscribe to the fund which was being raised to help the bereaved families.

On the motion of the Chairman it was resolved that the report be adopted and printed.

A ballot was taken for the officers and council for the ensuing year. Mr. Langdon and Mr. von Truenfeld acted as scrutineers. The following is the result as far as regards the officers of the Society:—President, Mr. Latimer Clark; Vice-Presidents, Prof. Abel, Mr. Culley, Prof. Foster, and Mr. Walker; Treasurer, Major Webber; Hon. Sec., Major Bolton.

Mr. Walter Hancock moved "That the best thanks of this Society be accorded to Prof. Sir William Thomson, F.R.S., for the manner in which he has filled the chair during the past year, and for the assistance that he has afforded the Society in furthering its proceed

ings." He said that he was sure that the motion would meet with the most cordial acceptance on the part of every member. The name of Sir William Thomson was a household word amongst electricians and other scientific men. He had conducted laborious investigations into the speed of the transmission of messages, and devised that most marvellous and beautiful instrument, the reflecting galvanometer, and also that very wonderful and simple instrument, the quadrant electrometer; and these three achievements were such as would stamp him for all time as a man who had left his mark on electrical science, and a most useful and indelible mark on telegraphy.

Mr. SIEVEWRIGHT seconded the motion, and spoke in the highest terms of the help and advantage which the Society had derived from Sir William Thomson during his presidency.

The motion was carried by acclamation.

Colonel STOTHERD moved "That the thanks of the Society of Telegraph Engineers be accorded to the President and Council of the Institute of Civil Engineers, for their continued liberality and kindness in affording this Society the free use of this magnificent hall, and the other apartments of the building."

Major WEBBER seconded the motion. He said that he hoped that the day, which was shadowed forth in the report, when they would have a hall of their own, was very far distant, for he felt sure that they would never get such a comfortable place as that in which they were now assembled. As treasurer, he thought that he could say that that day was really a distant one. (Laughter.)

The motion was carried unanimously. This concluded the business of the annual meeting.

An ordinary meeting also took place.

A paper on "*The Telegraph in the Ashantee War*," by Lieut. Jekell, R.E., was read and discussed.

An abstract of the paper, and a report of the discussion are reserved for a future number of the TELEGRAPHIC JOURNAL.

Notices of Books.

A Treatise on an Improved Method for overcoming Steep Gradients on Railways, whereby any Ordinary Locomotive, capable of Hauling a Given Load up a Gradient of 1 in 80, can take the same up 1 in 8. By HENRY HANDYSIDE, late Assistant Provincial Engineer to the Government of Nelson, New Zealand. London: E. and F. N. Spon, 48, Charing Cross. 8vo, sewed, 32 pages and 4 plates.

THE author in this pamphlet discusses the causes of the great expense attending the railways of the day, and proposes, by his system, to lessen it. This system consists in making locomotives capable of acting as a stationary engine, so that whenever steep gradients occur the engine can leave the train and ascend a certain distance, paying out, at the same time, a steel chain, with which to haul up the train. By thus providing a means for locomotives to haul trains up steep inclines, he confidently asserts that the necessity for long gentle gradients no longer exists, and that the wear and tear resulting from shorter railways (the difficulty of going straight to a station over a steep elevation rendering a winding route no longer expedient), together with thirteen other items of "savings," sufficiently recommend his system for the approval of Engineers and Railway Companies.

According to this system the engine is "coupled to the train by a steel chain wound round a drum, which is mounted in the framing of the engine. The drum is rotated direct, or with more advantage by gearing from a separate pair of cylinders, distinct from the usual cylinders which drive the locomotive, On each side of the engine framing, and also on each side of one or more carriages of the train, there are suspended self-acting gripping struts, which, when let down on the rails by the driver or guard, will firmly grip the sides of the rails and keep the engine or train stationary. On arriving at the foot of a steep incline the gear of the hauling drum is released, and the engine runs up the gradient to any desired distance." The engine is then fixed, by means of the gripping struts, to the rails, and proceeds to pull up the train close to itself. The struts attached to the train are then let down, and the engine again starts forward as before. It will be apparent that this method is slow work, and the delay occurring over a long line would seriously detract from its usefulness. For this reason we do not think that it will ever gain favour with engineers for ordinary railway purposes. For certain pursuits unconnected with general railway traffic we doubt not the system may prove highly suitable. But for routes where speed and heavy traffic is a desideratum we are of opinion this species of traction is thoroughly unsuited, and we conclude the author is of the same opinion, since he hopes "that with this new system a *fair average speed* may be maintained, with other and great commercial advantages, to compensate for any loss of time which may result from its adoption."

Electrical Science in English and Foreign Journals.

(In addition to our usual abstracts, there will be found under this heading the titles of papers on electrical science which have appeared in English and foreign journals from the commencement of the present century up to the date of the establishment of this journal).

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, Vol. lxxix., No. 19. November 9, 1874.

Electrostatic Induction Currents.—E. Becquerel.—I have repeated Verdet's and Masson's experiments, to determine the condition of an induced current, with one of Holtz's machines, and ascertained without difficulty that the conduct of the induced current varies with the strength of the inducing charge. Two Mattencci's disks contain the inducing and induced spiral. The latter is put in connection with the two ends of a cylindrical Geissler tube, 50 c.m. long. The first communicates, by one of its extremities, with the negative portion of the machine, whilst the other extremity is united to one of the plates of a condenser whose collector communicates with the positive portion of the machine. Two inverse currents, the one charging and the other discharging the condenser, traverse the inducing spiral. Those which are produced in the induced spiral very brilliantly light up the Geissler tube. With an explosive distance of 5 c.m. the difference in appearance of the two poles is distinctly noticed, but, by progressively diminishing the distance, it is possible to produce three inversions separated by moments when the appearance of the two poles is identical. At the instant when the explosive distance is about 3 c.m., large and spaced stratifications are formed; but before the last inversion they present all those characters which Ruhmkorff's coil affords. The same effects are produced by causing the distance of the spirals or condensing plates to be varied. The inversions prove that the phenomenon now studied has nothing in common with the lateral discharge, particularly characterised by the constancy of the condition of the current which it determines.

The Action of the Electric Current on the Organs of Sense.—T. L. Phipson.—Ever since 1792, Volta, in repeating Galvani's experiments, demonstrated that a

very weak electric discharge was capable of exciting contraction in a frog, if directed from the nerve to the muscle, whilst in the contrary direction no effect was produced Lehot equally concluded, from his experiments, that the effect of the current upon the nerves of an animal is different according as this current traverses in one direction or the other; and, according to him, when the current is directed in the direction of the nerve's ramifications the contractions are excited at the moment when the current passes; the contrary effect results under opposite conditions. But Matteucci, in studying the passage of the current in the cardiac and splanchnic nerves of a living animal, or one recently killed, did not discover any well-marked difference between the actions of the direct and inverse currents. From experiments I have carried out, it appears evident that Lehot should have spoken of the direction of the current independently of the direction of the nerves, whilst the fact observed by Matteucci will only apply to the nerves of the vegetative life. [Here follow numerous physiological experiments unsuited to our pages.]

No. 20. November 16, 1874.

On Electric Influence.—P. Volpicelli.—This note forms an appendix to those he has already published, and contains a list of other unpublished experiments which are to confirm his previous theories. The experiments are varied, and for particulars of them we refer our readers to the original article.

The Action Exercised by an Electro-Magnet on the Spectra of Rarefied Gases traversed by Electric Charges.—J. Chautard.—The spectra, characteristic of the matter into which the spark is thrown, present—under the influence of the magnet—very curious and special circumstances regarding the number, position, and degree of fineness of their rays. Experiments have hitherto only been made on the spectra of the metalloids, taking for types the elements indicated by M. G. Salet in his important work. Each body was enclosed in a Geissler tube, placed between the poles of an electro-magnet, and at a short distance from the slit of the spectroscope. The divisions of the micrometer, previously marked according to Frauenhofer's lines, allowed the corresponding colours of the spectrum to be freely examined. Then another tube—in every way analogous to the first, placed in communication with the reflecting prism, and away from the action of the magnet—permitted a second spectrum to be obtained close to the first, so as to serve a unit of comparison. Such disposition being arranged, a spark was passed into each of these tubes, and rays in perfect agreement were furnished by each spectrum. This agreement ceased directly the magnet was in action: one of the spectra preserved its original characteristic; the other, under magnetic influences, underwent remarkable modifications, more or less complicated and novel, according to the strength of the current, its direction, and the distance of the magnet, &c. The substances experimented with were hydrogen, chlorine, bromine, iodine, oxygen, sulphur, selenium, and nitrogen. The light from the sulphur and selenium experienced, under the magnet's action, a marked diminution in intensity,—so much so that the spectrum, very faint at first, disappeared after a few moments. Chlorine and bromine, on the contrary, were characterised by an increase in splendour, and the development of fine, numerous, and brilliant rays, especially in the green, whose appearance or disappearance when the contact-breaker was turned gave an extremely magical character to the experiment.

On Magnetism, and a New Exploder.—M. Trève.—The new exploder is a modification of Brèquet's mine exploder, and the remarks "On Magnetism" are merely the results of some few experiments with the modified machine. Brèquet's apparatus consists of a permanent magnet with a soft iron armature, of horse-shoe shape, around whose branches coils are wound: the make and break of armature and magnet contact induce powerful currents of opposite directions, which are utilised in the exploder. In M. Trève's modification he substitutes, for the straight permanent magnet, an electro-magnet of soft iron, of horse-shoe shape.

Les Mondes. Vol. xxxv., Nos. 9 and 10. October 29 and November 5, 1874.

The main part of this number—viz., 72 pages out of 92—is devoted to the speech of Prof. John Tyndall at the British Association Meeting at Belfast. The remainder of the number contains nothing suited to our pages.

Nos. 11 and 12. November 12 and 19, 1874.

These numbers publish no original articles on electrical subjects. The latter contains the Count du Moncel's paper on "The Effects of Polarisation which result from the Passage of Currents through Bad Conducting Materials," and which was received by us direct from the author (see TEL. JOURN., vol. ii., p. 345).

Moniteur Industriel Belge. Vol. i., Nos. 21 and 22. October 20 and November 1, 1874.

On Lightning Conductors.—M. Melsens.—M. Melsens, a member of the Belgian Academy, is carrying on a series of experiments to examine the state of the lightning conductors of the Central Markets of Brussels, and to ascertain what may be necessary to repair or replace them. An abstract will be given when the series of papers is complete.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. November, 1874.

Mixture of Copper and some other Metals by Electrolysis.—This paper is a translation from the *Zeitschrift fur das Berg-Hutten und Salinen-Wesen*, and is far too chemical and mineralogical in its nature to admit of full insertion into our columns. We therefore merely give an indication of the points dwelt upon as a guide to those who would desire to consult the article in the original. 1. *Electrolytic Mixture of the Copper contained in Rich Materials, with Various Compounds.* 2. *The Mixture of Nickel and Cobalt by Electrolysis.* In this paper engravings are given of a special description of battery used.

The Application of the Electrolytic Mixture Process of Metals to the Analysis of Copper and Nickel Alloys.—M. Herpin.—Another paper scarcely fit for full insertion in our pages, and supplemental to the previous paper.

Bulletin du Musée de l'Industrie de Belgique. October, 1874.

There is no article on electrical or telegraphic matters in this month's number.

Revista de Telégrafos. No. 21, Anno xiv. November 1, 1874.

This number contains, in addition to the official section, an account of the progress of Telegraphy in the Philippine Islands and in the Argentine Republic, a notice of the recent deep-sea soundings in the Pacific, and an article on the projection of maps.

Annalen der Physik und Chemie, von J. C. Poggendorff. No. 6.

On the Medium in Electric Influence.—H. Brongersma.—See pp. 376 and 390.

On the Crystalline Form and the Thermo-Electric Properties of Speis Cobalt.—P. Groth.

On Terrestrial Magnetic Measurements.—C. Braun.—Will appear in full.

No. 7.

Researches on Terrestrial Magnetic Measurements.—C. Braun.—(Continued.)

Thermo-Electricity.—P. Tait.

On the Electrolytic Preparation of Magnets.—W. Beetz.—The late Prof. Jacobi proposed to determine experimentally whether, by proper arrangement, precipitated iron can be induced to arrange itself so as to form permanent magnets. The author maintains that he solved the question twelve years ago, and obtained magnets by electrolysis. He finds that iron precipitated from a solution of iron containing sal-ammoniac is, in a very eminent degree, capable of permanent magnetism; that precipitated from other solutions of iron is magnetic only in a slighter degree. If the precipitate is obtained under the influence of powerful magnetism—prejudicial circumstances being avoided—strong magnets, of homogeneous structure, are formed from solutions containing sal-ammoniac. On the other hand, solutions free from sal-ammoniac yield magnets distinguished by their irregular structure, in consequence of which the feeble magnetism of the precipitate is rendered still weaker. A not unimportant degree of coercive power cannot, under any circumstances, be denied to iron, unless altered in its structure by ignition or other processes. The nature of the solutions themselves must be regarded as the cause of the irregularities of structure. Whilst the sal-ammoniacal solution remains perfectly clear, a solid crystalline layer is separated upon its surface. If pieces are broken off they fall to the bottom. Solutions of ferrous chloride become turbid, and continually deposit a slimy precipitate upon the electrodes. Klein's solution remains tolerably clear, but upon the surface is formed a slimy foam. If any of this falls down, the electrodes are likewise soiled. Thus the iron precipitate is deprived of its homogeneity, and by partial removal of the impurities—*e.g.*, by brushing and by the rise of gas-bubbles—the formation of "partial" magnets is explained.

Remarks on the Electric Machine.—It has been mentioned that the revolving disk in Helmholtz's machine should be as thin as possible to give a good action. Veltmann concludes from his theory—according to which this disk, at right angles to its surfaces, is an electric conductor (*Ann.*, Bd. 151, S. 514)—that the action would reach its maximum if the thickness of the disk could be made = 0. Against this view I must remark that in the year 1869 (*Ann.*, Bd. 136, S. 174), I mentioned that I obtained exactly the same action with a disk, 3 Paris lines in thickness, of good old mirror glass, as with a disk of common window glass. Latterly I have found this confirmed on fixing upon the axle, instead of one disk of blown glass, two, and causing them to rotate together. Each of these disks was 3 m.m. in thickness. Neither in the length of the sparks (maximum 8 Paris inches) nor in their number could any decrease be perceived in consequence of this combination. This applies to the machines of the first kind; whether it holds good for the second has not been experimentally examined, though I see no reason to doubt it.

No. 8.

Experimental Researches on Electric Vibrations.—N. Schiller.

Researches on Terrestrial Magnetic Measurements.—C. Braun.

The Magnetising Function of a Ball of Soft Iron.—C. Fromme.

Effects of Lightning on the Tower of St. Martin's, at Basle.—E. Hagenbach.

Reply to Herweg's Remarks on an Essay "On the Nature of Electricity."—E. Edlund.

No. 9.

On the Electric Residue.—A. Wüllner.

On the Connection of the Elasticity of Caoutchouc with Temperature.—F. Exner.

New Observations on Electric Machines of the Second Kind.—J. C. Poggendorff.

Observations on the Behaviour of Iron and Steel in the Galvanic Current.—H. Herweg.

An Electro-Dynamic Experiment.—F. Zöllner.

An Acoustic Pyrometer.—J. Chautard.

These papers will all appear, either *in extenso* or in abstract.

Poggendorff's Annalen der Physik und Chemie.
Vol. LV. (1842).

Measurement of Strong Galvanic Currents in Absolute Measure. M. Weber. P. 27.
Remarks on the Action of Magnets at a Distance. M. Weber. P. 33.
Methods for Determining the Relative Maxima of Current Strength of Two Voltaic Batteries. M. Poggendorff. P. 43.
Phenomena in Passage of Galvanic Sparks. P. 62.
Some New Researches on the Nature of the Electric Spark. M. Bann. P. 121.
On the Theory of Combined Voltaic Batteries. M. Poggendorff. P. 158.
Experiments by Elkington and Ruolz in Electroplating with Gold or with other Metals. P. 160.
On the Cause of Thermo-Electricity. Baron Von Wrede. P. 175.
On the Electro-Chemical Equivalent of Water. M. Weber. P. 181.
On Transitory Magnetism excited in Steel by Galvanic Action. M. Fechner. P. 189.
Researches on some Anomalous and Normal Galvanic Phenomena. M. Henrici. Pp. 253, 455.
On the Preparation of a Carbon to replace the Platinum in a Grove Battery. M. Bunsen. P. 265.
Improved Arrangement of the Voltameter for obtaining separately the Two Constituents of Water. M. Poggendorff. P. 277.
On the Oersted Electrometer. M. Dellmann. P. 301.
Researches on the Passivity of Metals and on the Theory of the Voltaic Battery. M. Martens. Pp. 437, 612.
On Electricity in Preparation of the so-called Machine-Paper. M. Hankel. P. 477.
On a Phenomenon of Division of Electric Currents. M. Poggendorff. P. 511.
On Chemical Rays of Light and their Electric Actions. M. Becquerel. P. 588.

Vol. LVI. (1842).

On the Thermo-Electricity of Topaz. M. Hankel. P. 37.
Some Experiments on the Influence of Form and Temperature on Electricity of Boracite. M. Hankel. P. 58.
Electro-Chemical Researches on the Voltaic Polarisation of Solid and Liquid Conductors. M. Schönbein. Pp. 135, 235.
On the Opposite Current at Beginning and End of a Primary. M. Dove. P. 251.
On Electric Currents Induced through Approximation of Massive Iron and Bundles of Iron Wire to a Steel Magnet. M. Dove. P. 268.
On the Question whether the Spark observed at Interruption of a Wire conveying a Current appears at the Moment of Interruption, or a Measurable Time after this. M. Dove. P. 274.
On the Use of the Galvanometer as a Measuring Instrument. M. Poggendorff. P. 324.
On M. De la Rive's Hypothesis of a Return Current in the Voltaic Battery. M. Poggendorff. P. 353.

On the Means of Increasing the Sensibility of a Galvanometer. P. 370.
On the Best Construction of Thermo-Electric Apparatus. M. Svanberg. P. 422.
On the Resistance of the Human Body to Galvanic Currents. M. Lenz. P. 429.
A New Instrument for Measuring Magnetic Inclination and its Variations. Mr. Lloyd. P. 441.
On Sudden and Complete Removal of the Attractive Force from Electro-Magnets. Mr. Alexander.
Action of Flame on Tension-Electricity. M. Petrina. P. 459.
Thermo-Chemical Researches. M. Hess. Pp. 463, 593.

Vol. LVII. (1842).

Connection between Electricity and Evaporation. P. 34.
On some Electrolytic Actions of the Simple Battery. M. Schönbein. P. 35.
A Method of Determining the Constants of the Voltaic Battery. M. Jacobi. P. 85.
On Galvanic Batteries constructed with Chromic Acid. M. Poggendorff. P. 101.
On Galvanometry. M. Petrina. P. 111.
On the Theory of Magnetic Machines. M. Lenz. P. 241.
On the Portative Force of Horse-Shoe Magnets, and on the Time of Oscillation of Straight Magnetic Bars. M. Haecker. P. 321.
On Electric Copies. M. Karsten. P. 492.
Thermo-Chemical Researches. M. Hess. P. 569.
On the General Galvanometric Law. M. Poggendorff. P. 609.

Vol. LVIII. (1843).

Preliminary Note on the so-called Frog-Current, and on Electromotive Fishes. M. Du Bois Reymond. P. 1.
Researches on Bound Electricity. M. Knochenhauer. Pp. 31, 211, 391.
On the Voltaic Fundamental Experiments. M. Dellmann. P. 49.
Researches on some Anomalous and Normal Galvanic Phenomena. M. Henrici. Pp. 61, 375.
Thermo-Electric Opposite Current. P. 76.
On Electric Copies. M. Karsten. P. 115.
On a Voltaic Gas-Battery. Mr. Grove. P. 202.
On Galvanic Use of Sodium-Amalgam. M. Henrici. P. 232.
On the Chemical Action of Galvanic Currents. M. Martens. P. 234.
Some Notes on Galvanic Conduction. M. Jacobi. P. 409.
On the Dividing Action of Static Electricity. Mr. Faraday. P. 603.

Vol. LIX. (1843).

Description of an Improved Voltagometer. M. Jacobi. P. 145.
On the Laws of Heat Development through the Galvanic Current. M. Lenz. Pp. 203, 407.
On the Nature of the Peculiar Swell produced at the Positive Pole of a Battery during Water-Electrolysis, as also in Outflow of Electricity from Points. M. Schönbein. P. 240.
On a Peculiar State of Glass observable with the Electroscope. M. Heintz. P. 305.
On the Pyro-Electricity of Minerals. MM. Riess and and Rose. P. 353.
On the Influence of Pressure on Voltaic Decomposition of Water. M. de la Rive. P. 420.
New Observations on the Chemical Action of the Simple Battery and the Passivity of Iron. M. Schönbein. P. 421.
On Induction Currents Excited by Action of the Earth. MM. Palmieri and Santi Linari. P. 641.

(To be continued.)

City and Commercial Notes.

At the adjourned meeting, on Monday, the 30th ult., of the Direct United States Cable Company, Limited (called for the purpose of considering the advisability of raising capital to duplicate the cable), the proceedings were further adjourned for a fortnight, in compliance with the wish of several large Shareholders.

The number of messages passing over the Cuba Submarine Telegraph Company's line during the month of October was 1794, estimated to produce £2000, against 859 messages, producing £896, in October last year.

The traffic receipts of the Eastern Extension, Australasia, and China Telegraph Company, Limited, for the month of November, 1874, amounted to £17,728, against £17,454 for the corresponding period of 1873.

The Eastern Telegraph Company's traffic receipts for the month of November, 1874, were £33,060, against £35,096 in the corresponding period of 1873.

The Eastern Extension, Australasia, and China Telegraph Company have declared an interim dividend, for the quarter ending September 30, of 3s. per share, or 6 per cent per annum.

The traffic receipts of the Direct Spanish Telegraph Company, Limited, for November, were £1224 10s., against £1386 11s. 8d. in October.

TELEGRAPH SHARE LIST.

Amount per Share.	Name of Company.	Amount paid up.	Closing Quotations.
£		£	Dec. 11.
Stock	Anglo-American (Limited)	100	73—73½
10	Brazilian Submarine..	All	7½—7⅝
10	Cuba	All	5½—6
10	Direct Spanish	9	..—..
20	Direct United States Cable	All	10½—11½
10	Eastern (Limited)	All	7⅜—7⅝
..	Do., New	..	103—105
10	Eastern Extn. Australia and China	All	7⅜—7⅝
10	Globe Telegraph and Trust	All	6½—6⅝
10	Do., 6 per cent Pref...	All	9½—10½
10	Great Northern	All	11—11½
25	Indo-European	All	17—18
10	Mediterranean Extension (Limited)	All	3⅜—4½
10	Do., 8 per cent Pref...	All	10½—11
10	Panama and South Pacific	2½	..—..dis
8	Reuter's..	All	11—11½
Stock	Submarine	100	206—211
1	Do., Scrip	All	2—2½
10	West India and Panama	All	3½—3⅝
10	Do., 10 per cent Pref.	All	8½—9
20	Western and Brazilian (Limited) ..	All	11½—11⅝
1000 dis.	West Un. U.S. 7 per cent 1st M.B.	All	102—104
10	Hooper's Telegraph Works	All	12½—13½
50	India-Rubber and Gutta Percha ..	All	21—23
Cert.	Submarine Cables Trust	100	105—108
12	Telegraph Construction	All	27½—28
100	Ditto Ditto 7 per cent Bonds	All	103—105

To Correspondents.

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SUBSCRIPTIONS.

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Cheques and Post Office Orders to be made payable to Henry Gillman, and to be crossed "London and County Bank."

ALL SUBSCRIPTIONS PAYABLE IN ADVANCE.

In No. XLIII. of the Journal is published a "Comparative Statement of Government Telegraphs for the Year 1872." This, as is there stated, was copied from the American "Journal of the Telegraph, but we find that it originally appeared in the "Journal Telegraphique" for April 25th, 1874, and was drawn up from the official documents by the Bureau International des Administrations Telegraphique, at Berne.

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